

**AMERICAN SOCIETY OF HEATING, REFRIGERATING AND
AIR-CONDITIONING ENGINEERS, INC.
1791 Tullie Circle, NE Atlanta, GA 30329 404-636-8400**

TC/TG/TRG MINUTES COVER SHEET

(Minutes of all meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/TRG NO. TC 7.5 **DATE: July 5, 2006**

TC/TG/TRG TITLE: Smart Building Systems

DATE OF MEETING: June 27, 2006 **LOCATION: Quebec City, QC CANADA**

Members Present	Appt	Members Absent	Appt	Ex-Officio Members and Additional Attendance
John House, Chair (V)	05-07	Osman Ahmed (V)	02-06	James Earley
Michael Brambley, Vice Chair, Research Subc., (V)	04-08	James Braun (V)	03-07	Sira Gopalnarayanan
Steve Blanc, (V)	05-09	Cliff Federspiel (V)	02-06	Patrick Hughes
Michael Brandemuehl	03-07	Bill Healy (V)	04-08	Haorong Li
James W. Gartner (V)	03-07	Jonathan Wright, IM (V)	03-07	Damian Ljungquist
Agami Reddy (V)	02-06	Peng Xu, Wireless Apps. Subc., (V)	05-09	Scott Mitchell
				John Murray
David Bornside, CM	04-	Narendra Amarani, CM	04-	Mike Porter
Natascha Castro, FDD Subc., Web Master, CM	04-	Dave Branson, CM	01-	Gene Strehlow
Maria Corsi, CM	03-	Barry Bridges, CM	02-	Meli Stylianou
Rich Hackner, Program Subc., CM	05-	Marty Burns, CM	02-	Kris Subbarao
Srinivas Katipamula; Bldg/Util. Int. Subc., CM	05-	Jim Butler, CM	02-	Shengwei Wang
George Kelly, CM	01-	Charles Culp, CM	00-	Jerry While
Carol Lomonaco, CM	00-	Arthur Dexter, CM	05-	
Leslie Norford, Handbook Subc, CM	03-	Piotr Domanski	05-	
Robert Old, CM	00-	Mohsen Farzad	05-	
John Seem, CM	03-	Carlos Haiad, CM	04-	
Keith Temple, CM	03-	Phil Haves, CM	05-	
Jin Wen, CM	05-	Mark Johnson, CM	04-	
Xiaohui Zhou, CM	03-	David Kahn, CM	96-	
		Michael Kintner-Meyer, CM	03-	
		Mingsheng Liu, CM	03-	
		Darrell Massie, CM	03-	
		John Mitchell, CM	00-	
		Ron Nelson, CM	98-	
		Hung Mahn Pham, CM	01-	
		Kinga Porst, CM	02-	
		Mike Pouchak, CM	03-	
		Andrew Price, CM	03-	
		Barry Reardon, CM	99-	
		Glenn Remington, CM	02-	
		Todd Rossi, Secretary, CM	03-	
		Vern Smith, CM	05-	
		Pornsak Songkakul, CM	02-	
		James Winston, CM	96-	
		Chariti Young, CM	02-	
		Xiaohui Zhou, CM	03-	

(V) = voting member

DISTRIBUTION:

ALL MEMBERS AND CORRESPONDING MEMBERS OF TC/TG/TRG,

TAC CHAIR: Patricia Graef

TAC SECTION HEAD: Janice Peterson

ALL COMMITTEE LIAISONS AS SHOWN ON TC/TG/TRG ROSTERS:

Program: William Klock

Standards: Richard Hermans

Research: Patrick Hughes

Special Publications: Kimball Ferguson

CTT: Joseph Anderson

Staff Liaison (Stds): Claire Ramspeck

Prof. Dev.: Julian De Bullet

Staff Liaison (Resch/Tech Srv): Michael Vaughn

"These draft minutes have not been approved and are not the official, approved record until approved by this (council/committee)."

ASHRAE TC Activities Sheet

DATE: June 27, 2006

TC NO. TC 7.5

TC TITLE: Smart Building Systems

CHAIR: John House

VICE CHAIR: Mike Brambley

TC Meeting Schedule

Location, past 12 mo.	Date	Location, next 12 mo.	Date
Chicago	1/24/06	Dallas	1/30/07
Quebec City	6/27/06	Long Beach	6/26/07

TC Subcommittees

Subcommittee	Chair
Fault Detection and Diagnostics	N. Castro
Wireless Applications	P. Xu
Building/Utility Interface	S. Katipamula
Research	M. Brambley
Program	R. Hackner
Handbook	L. Norford

Program List for 2007 Dallas Meeting:

Title	Chair	Status
“Emerging Wireless Technologies” – Seminar	M. Brambley	
“Automated Fault Detection and Diagnostics: Are You Ready to Put it in Your Building?” – Forum	M. Brambley	
“Approaches to Deploying Wireless Technologies” – Seminar	J. Wen	
“Fault Detection and Diagnostics – But What About Correction” – Seminar	S. Katipamula	

Current Research Projects

1275-RP “Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers – Phase II” (Phil Haves – PMSC Chair)

1274-RP “Field Performance Assessment of Package Equipment to Quantify the Benefits of Proper Service” (Todd Rossi – PMSC Chair)

1312-RP “Tools for Evaluating FDD Methods for AHUs” (Phil Haves – PMSC Chair)

2005 – 2006 Research Plan

Proposed Priority	Old Priority	Project	Contributors	Status
1	1	Fault Detection and Diagnostics for Centrifugal Chillers – Phase 3: Real-Time Implementation	WS Contributors Srinivas Katipamula. RTAR Contributors: Srinivas Katipamula, John House, Todd Rossi, Jim Braun, Natascha Castro	Draft WS developed. Final draft is pending submission of 1275-RP report. TC 8.2 approved for co-sponsorship at the Quebec City meeting. The project has rolled off the RTAR list, but Patrick Hughes, Sec 7 Research Liaison, will take care of this.
2	3	FDD for Supermarket Refrigeration	RTAR Contributors Daniel Choinere and John House	Approved in Denver. Discussed in Quebec City. Revised work statement to be drafted for Dallas. TC 10.7 is assisting and will co-sponsor. Rolls off the RAC list in August 2007.
3	4	Development of metrics to evaluate benefits of sensor networks in buildings (new title)	RTAR Contributors Jin Wen and Agami Reddy. Revised by Bill Healy	Approved by full TC in Denver with minor revisions. Received comments from RAC and will be revised accordingly. An email ballot is planned.
4	5	“What If” Emulation Tool for Training and Strategizing on Building Operations	Steve Blanc	Revised draft of RTAR to be prepared for Dallas.
5	New	Residential Demand Response		New in Quebec City
6	New	Commercial Demand Response		New in Quebec City
7	6	Whole-Building FDD	Les Norford	On hold. Les is still interested in pursuing the idea.
8	2	Conceptual Design of a Self-Configuring HVAC Control System	Michael Kintner-Meyer	Revised draft WS discussed in Denver. Revisions planned. Tabled indefinitely. The RTAR has rolled off the RAC list.

Co-Sponsorship

	Real-Time Optimal Control in a Distributed Environment	Jim Braun, George Kelly, Maria Corsi	RTAR submitted by TC 7.4, TC 7.5 is co-sponsor. RTAR has been approved. No Progress to report.
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Technical Papers from Sponsored Research

RP-1011

Final report for ASHRAE Research Project RP-1011, "Utility/Energy Management and Control Systems (EMCS) Communication Protocol Requirements" is available on the TC 7.5 web site.

RP-1020

Norford, L. K., J. A. Wright, R. Buswell, and D. Luo. 2000. "Demonstration of Fault Detection and Diagnosis Methods in a Real Building (ASHRAE 1020-RP)." ASHRAE 1020-RP Final Report.

Luo, D., L. K. Norford, S. R. Shaw, and S. B. Leeb. 2002. "Monitoring HVAC Equipment Electrical Loads from a Centralized Location - Methods and Field Test Results." ASHRAE Transactions Vol. 108(1).

Shaw, S. R., L. K. Norford, D. Luo, and S. B. Leeb. 2002. "Detection of HVAC Faults via Electrical Load Monitoring." International Journal of HVAC&R Research, 8(1):13-40.

Norford, L.K., J. A. Wright, R. A. Buswell, D. Luo, C. Klaassen, and A. Suby. 2002. "Demonstration of Fault Detection and Diagnosis Methods for Air-Handling Units (ASHRAE 1020-RP)." International Journal of HVAC&R Research, 8(1):41-72.

RP-1043

Bendapudi, S., Braun, J.E., and Groll, E.A., "A Dynamic Model of a Centrifugal Chiller System – Model Development, Numerical Study and Validation," ASHRAE transactions, Vol. 111, Pt. 1, 18 pages, 2005.

Final report for ASHRAE Research Project RP-1043, " Fault Detection and Diagnostic Requirements and Evaluation Tools for Chillers" is available on the TC 7.5 web site.

Technical paper from 1043-RP, Comstock, M.C., Braun, J.E., and Groll, E.A., "The Sensitivity of Chiller Performance to Common Faults," International Journal of HVAC&R Research, Vol. 7, No. 3, pp. 263-279, 2001.

Technical paper from 1043-RP, Comstock, M.C., Braun, J.E., and Groll, E.A., "A Survey of Common Faults for Chillers," ASHRAE Transactions, Vol. 108, Pt. 1, 2002.

RP-1139

Andersen, K.K., and Reddy, T.A., 2002. "The Error in Variable (EIV) Regression Approach as a Means of Identifying Unbiased Physical Parameter Estimates: Application to Chiller Performance Data", International Journal of HVAC&R Research, vol.8, no.3, pp. 295-309, July.

Reddy, T.A. and Andersen, K.K., 2002. "An Evaluation of Classical Steady-state Off-line Linear Parameter Estimation Methods Applied to Chiller Performance Data", International Journal of HVAC&R Research, vol.8, no.1, pp.101-124.

Reddy, T.A., Niebur, D., Andersen, K.K., Pericolo, P.P. and Cabrera, G., 2003. "Evaluation of the Suitability of Different Chiller Performance Models for Online Training Applied to Automated Fault Detection and Diagnosis", International Journal of HVAC&R Research, Vol.9, No.4, pp. 365-384, October.

Reddy, T.A., Andersen, K.K. and Niebur, D., 2003. "Information Content of Incoming Data During Field Monitoring: Application to Online Chiller Modeling", International Journal of HVAC&R Research, Vol.9, no.4, pp.385-414, October.

TC Sponsored Symposia (past 3 years, present, planned)

Title	Date (Given or Planned)
FDD, Operation and Maintenance of HVAC Systems (Kelly, TC 1.4 co-sponsor)	Kansas City, 6/03
Automated Functional Testing: Methodologies and Air-Handling Unit Applications (House)	Orlando, 1/05
Software Tools for Enhanced Building Operation (House)	Dallas, 1/07

TC Sponsored Seminars (past 3 years, present, planned)

Title	Date (Given or Planned)
Wireless Sensors for Building Applications (Healy, TC 1.4 co-sponsor)	Kansas City, 6/03
Improved Operations for California Buildings -Part 1 (Haiad, TC 7.4 lead)	Anaheim, 1/04
Improved Operations for California Buildings -Part 2 (Scruton, co-sponsored with TC 7.4)	Anaheim, 1/04
Automated Commissioning Tools (Maria Corsi, co-sponsored with TC 7.3)	Anaheim, 1/04
State of the Art Issues for DDC Systems (Atkinson, TC 1.4 lead)	Anaheim, 1/04
Models for Automated Building/HVAC Fault Detection and Diagnostics (Brambley, co-sponsored with TC 4.7)	Nashville, 6/04
Demand Response and Building Control (Xu, TC 7.4 lead)	Nashville, 6/04
Control Challenges and Opportunities with Emerging DDC Technologies (Bridges, TC 1.4 lead)	Orlando, 1/05
Future Intelligent Control Systems: They are Here Today (Braun, TC 7.4 lead)	Orlando, 1/05
Load Management: Why You Should Care and What Technology is Emerging (Katipamula, TC 1.4 and TC 7.4 co-sponsor)	Chicago, 1/06
User Experience with HVAC Fault Detection and Diagnostics – Part 1 (Cherniack, TC 1.4 and 7.6 co-sponsor)	Quebec City, 6/06
User Experience with HVAC Fault Detection and Diagnostics – Part 2 (Thomle, TC 1.4 and 7.6 co-sponsor)	Quebec City, 6/06
Emerging Wireless Technologies (Brambley)	Dallas, 1/07
Approaches to Deploying Wireless Technologies (Wen)	Dallas, 1/07
Fault Detection and Diagnostics – But What About Correction (Katipamula)	Dallas, 1/07

TC Sponsored Forums (past 3 years, present, planned)

Title	Date (Given or Planned)
Achieving Market Acceptance of HVAC Fault Detection and Diagnostic Systems (Goetzler, co-sponsored with TC 7.4)	Orlando, 1/05
What the utility wants to do to your building and how you will benefit (Kintner-	Denver, 6/05

Meyer, TC 7.4 co-sponsor)	
Wireless Sensing and Control: Where is it Needed and What Should it Control? (Brambley, TC 1.4 co-sponsor)	Chicago, 1/06
Fault Detection and Diagnostics: Are You Ready to Put it in Your Building? (Brambley, TC 1.4 and 7.6 co-sponsor)	Dallas, 1/07

TC Sponsored Public Sessions (past 3 years, present, planned): None

Journal Publications (past 3 years, present, planned): None

ASHRAE TC 7.5, Smart Building Systems

June 27, 2006

Call to Order, Roll Call, Introductions

The meeting was called to order at 3:35 PM with Chairman John House presiding. Roll call was taken with 6 of 11 voting members in attendance. House distributed the Agenda (the call-to-meeting letter and the agenda are in Appendix A).

Voting members present: Steve Blanc, Michael Brambley, Michael Brandemuehl, James Gartner, Agami Reddy, and John House

Voting members absent: Osman Ahmed, Jim Braun, Cliff Federspiel, Bill Healy, Jonathan Wright (International Member), Peng Xu,

Committee Scope

House read the committee scope for the benefit of all in attendance. (see Appendix B)

Approval of Minutes

House distributed copies of the Chicago minutes. No changes to the minutes were identified.

Motion: Move to approve the minutes of the Chicago meeting. Motion: Mike Brambley;
Second: Agami Reddy.

Vote: 6-0-0; chairman voting.

Chair's Announcements – John House

House attended the Chair's Breakfast on Sunday morning and reported the following announcements stemming from the meeting:

1. 160 programs were submitted for Quebec City, so some could not be scheduled due to space/time limitations. Programs bumped this time will almost surely get slotted the next meeting (assuming appropriate TC prioritization). Also, commercialization reviews can be done onsite, but please allow adequate time for the review prior to your program session. Online reviews for commercialism are possible and encouraged.

TCs are encouraged to pay attention to themes for future meetings. This will help assure that a program will be slotted. Program themes for upcoming meetings are:

- Get Energized in Dallas: Energy Efficient Strategies for Buildings

- ASHRAE the Natural Way: Natural Ventilation (Long Beach)
2. Volunteers are being sought from appropriate TCs and TGs to review the society's existing position document on energy to determine if significant changes or updates are required to the document before it is reaffirmed at the Dallas meeting. Interested individuals should contact Mike Vaughn, morts@ashrae.net.
 3. Volunteers are being sought from TCs and TGs to respond to technical questions from students competing in the national Solar Decathlon Design Competition. Questions will be filtered and are expected to be submitted during Society year 2006-2007 and a 1-week turn-around is expected on most responses. Interested individuals should contact Mike Vaughn.
 4. ASHRAE is now accepting abstracts for Indoor Air Quality 2007 titled "Healthy and Sustainable Buildings", which will be held Oct. 14-17, 2007 in Baltimore. Visit www.iaq2007.org for more information.
 5. A password-protected link to each TC or TG roster for Society year 2006-2007 will be e-mailed to all TC and TG members in the next few weeks. If you do not receive this e-mail, please contact Tara Thomas at tthomas@ashrae.org.
 6. Nominations for the 2006-2007 George B. Hightower Award honoring an exceptional TC/TG member are due September 30, 2006.
 7. President Lee Burgett has offered to send thank you letters to employers thanking them for supporting their employees who have participated in ASHRAE TCs and TGs this past Society year.
 8. ASHRAE has approved a new Strategic Plan. The plan includes four Directives:
 - ASHRAE will lead the advancement of sustainable building design and operations.
 - ASHRAE will be a world-class provider of education and certification programs.
 - ASHRAE will position itself as a premier provider of HVAC&R expertise.
 - ASHRAE will be a global leader in the HVAC&R community.

The first Directive has been assigned to Tech Council by the Board of Directors and includes a number of specific strategies for satisfying the Directive. Because of the emphasis on design and operations, much of the challenge of satisfying this Directive will fall to Sections 4 and 7. Action items for satisfying the Directive will be developed between now and September 30 under the direction of members of Tech Council, TAC and RAC.

Tech Council wants TCs to bias their workplans toward the Society's Strategic Plan and to communicate anything that contributes to the strategic plan through TAC and Tech Council.

The ASHRAE Strategic Plan is different from the ASHRAE Strategic Research Plan. RAC is making efforts to identify how the Strategic Research Plan supports the

Fault Detection and Diagnostics Subcommittee – Natascha Castro

The meeting began with a review of the ongoing research projects:

1. 1274 RP, “Field Performance Assessment of Packaged Equipment to Quantify the Benefits of Proper Service.” [PMSC Chair: Todd Rossi]
2. 1312 RP, “Tools for Evaluation FDD for AHUs” [PMSC Chair, Phil Haves]
3. 1275 RP, “Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers - Phase II.” [PMSC Chair, Phil Haves]

The meeting was focused on the development of a work statement and two RTARS.

The work statement, , **“WS Chiller Phase III – Fault Detection and Diagnostics for Centrifugal Chillers, Phase III: Real Time Implementation.”** Is follow on to the ongoing 1275 RP. Srinivas Katipamula presented the main issues that were discussed (see subcommittee minutes for details). He reported on the status of Phase II, that a draft version of final report was reviewed by PMS who recommended acceptance w/ changes. Final report will be submitted at the end of July to close the project. It was suggested that an email ballot follow review/endorsement of the work statement by TC 8.2 (Centrifugal Machines).

Two RTARS discussed were: **“Fault Detection and Diagnostic Methods for Supermarkets”** [RTAR Champion: John House] and **“A Building Systems Emulation Tool for Building Operators”** [RTAR Champion: Steve Blanc] These are being developed in small groups with revisions to be presented in Dallas.

The last part of the meeting was a brainstorming of new ideas, which then fed into program discussions.

Wireless Applications Subcommittee – Mike Brambley for Peng Xu

Mike Brambley chaired the subcommittee meeting and reported in place of Bill Healy who was not able to attend the meeting in Quebec City. He reported as follows.

Sensor Networks RTAR – Bill Healy, who leads this RTAR, was not present at the subcommittee meeting. The plan is to submit the revised RTAR in August or December. Brambley will contact Healy after the meeting.

Control Network Faulty Behavior – This is an idea for an RTAR. No progress was reported. Cliff Federspiel, who leads development of the idea was not present at the meeting. Jin Wen volunteered to help with writing the RTAR and Srinivas Katipamula volunteered to serve as a reviewer.

Practical Issues in Using Wireless in Building Controls – Bob Old reported that there has been no progress since the last meeting. A draft RTAR or paragraph description of the two ideas for the topic will be prepared before the next meeting. Carol Lomonaco volunteered to assist Bob.

New Business – Agami Reddy pointed out that wireless technology is apparently out in the market, but there are no guidelines for use. TC 7.5 might develop such guidelines. Discussion

of this topic lead to 3 program ideas:

- Emerging Wireless Technology and Applications
- Emerging Sensing Technologies
- Deployment of Wireless Technology

Building/Utility Interface Subcommittee – Srinivas Katipamula

Srinivas Katipamula, the Building/Utility Interface subcommittee chair, began the meeting by noting that the TC Chair created this new sub-committee before the last meeting in response to members request to re-focus the research areas. This is the second meeting for the subcommittee. The draft scope was circulated for members to provide feedback and changes by email. Srinivas noted that there were less than 10 people in attendance at the subcommittee meeting. He further added that much subcommittee discussion was devoted to brainstorming for new ideas. Rich Hackner volunteered to draft an RTAR for the next meeting on commercial building demand response, and Jin Wen volunteered to draft an RTAR on residential building demand response.

Research Subcommittee – Mike Brambley

Mike Brambley reported as follows.

Report from Research Chairs Breakfast

There is a new ASHRAE Strategic Plan. It can be found at ASHRAE.org/StrategicPlan.

Section 7 aligns with Directive 1: “ASHRAE will lead the advancement of sustainable building design and operations.”

Research Strategic Plan supports the ASHRAE Strategic Plan; it does not replace it.

Reminders on RTARs and work statements:

- 45% is given for “Supports ASHRAE Strategic Plan and Research Strategic Plan.”
- RAC now reviews RTARs 3 times per year. Due dates are 8/15, 12/15 and 5/15.
- Involve your Section Research Liaison – Patrick Hughes.
- Research information can be found on the web at www.ashrae.org/TechnologyandStandards/Research.

Project maximum funding is now \$250K.

New TC research plans are due August 15.

Report on Research Subcommittee Meeting

Status of Ongoing Research Projects:

1274RP: The project has a 1-year no-cost extension. There may be technical problems – 40% of the units were measured before the need to revise the field measurement protocol was

discovered. The PMS is working with the contractor and our research liaison to resolve this.

1312-RP: The project has been underway for 8-9 months. It is progressing but possibly ~4 months behind schedule. It may need a time extension, but it is too early to judge and request one.

1275-RP: The final report is completed. The PMS recommends that the TC vote to approve the report with revisions. Srinivas Katipamula elaborated on the revisions in the meeting.

A revised TC 7.5 research plan was distributed. It was discussed and voted on.

Motion: Move to accept the research plan as prioritized. Motion: Mike Brandemuehl; Second: Jim Gartner.

Vote: 6-0-0; chairman voting.

Program Subcommittee – Rich Hackner

Rich Hackner led a discussion of program topics for the upcoming meetings. The following programs were proposed as the prioritized program plan for Dallas:

1. “Emerging Wireless Technologies” – Seminar (Chair: Mike Brambley)
2. “Automated Fault Detection and Diagnostics: Are You Ready to Install it in Your Building?” – Forum (Moderator: Mike Brambley)
3. “Approaches to Deploying Wireless Technologies” – Seminar (Chair: Jin Wen)
4. “Fault Detection and Diagnostics – But What About Correction?” – Seminar (Chair: Srinivas Katipamula)

Hackner also reported that House is planning a symposium for Dallas titled “Software Tools for Enhanced Building Operations.”

Motion: Move to approve the prioritized program plan for Dallas. Motion: Agami Reddy; Second: Jim Gartner.

Vote: 6-0-0; chairman voting.

Brambley reported that TC 7.3 is attempting to put together a two-part seminar titled “Bridging the Gap Between Design and Operation”. They are looking for speakers who might be able to address the role of data and life-cycle data in bridging the gap. Other topics that offer ways to bridge the gap between design and operation will also be considered.

Handbook Subcommittee Report – Les Norford

Les Norford reported that TC 7.3 has voted to approve their revised handbook chapter on “Operations and Maintenance Management” that includes material on the topic of fault detection and diagnostics provided by TC 7.5. The material was integrated into the existing material instead of being added as a stand-alone section. Norford did not think it was possible or appropriate for TC 7.5 to vote on acceptance of the material. He indicated TC 7.3 was agreeable to adding an acknowledgement that the material on FDD was provided by TC 7.5 and suggested that the TC 7.5 chair (House or Brambley) write a letter to TC 7.3 thanking them for this opportunity to include our material in their handbook chapter. Brambley reported that TC 7.3 had formally voted earlier in the day to add an attribution to TC 7.3 to their chapter. House thanked Norford, Brambley, and Gartner for their efforts working with TC 7.3 and for getting

the first information on FDD into the handbook.

ACTION: House will write a letter to TC 7.3 to thank them for allowing TC 7.5 to include material on the topic of fault detection and diagnostics in their handbook chapter on “Operations and Maintenance Management”.

Web – Natascha Castro

All TC and TG chairs need to review their websites immediately and confirm they are up to date with minutes posted from the 2006 Chicago meeting and that rosters containing member contact information are not posted.

ACTION: Natascha Castro will post the 2006 Chicago minutes and confirm that rosters containing member contact information are not posted.

Homeland Security

Nothing to report.

Old Business

Nothing to report.

New Business

1. House and others attending the meeting announced several upcoming conferences that may be of interest to meeting attendees:
 - The 9th REHVA World Congress Clima 2007 will be held June 10-14, 2007, in Helsinki, Finland. For more information, visit the web site at www.clima2007.org.
 - IBPSA-USA will host its second national conference “SimBuild 2006”, August 2-4, 2006 on the campus of the Massachusetts Institute of Technology. Registration information is available at <http://www.ibpsa.us>.
 - “Energy Sustainability 2007”, organized by Solar Energy Division and Advanced Energy Systems Division of ASME International, will be held June 27-29, 2007, in Long Beach, California. Abstracts should be submitted to <http://www.asmeconferences.org/ES2007>.
 - The “Canadian Solar Buildings Conference” will be held in Montreal, Aug. 20-24, 2006. The conference is organized by the Solar Buildings Research Network. Information about the conference can be found at www.solarbuildings.ca.
2. House suggested that TC 7.5 consider identifying liaisons to specific committees within the Society whose activities are of interest to TC 7.5. Liaisons could then report on the activities of those committees at the main committee meeting. Attendees were supportive of the idea. Brandemuehl suggested we broaden this idea to include committees and/or organizations outside of ASHRAE. The following individuals volunteered to serve in a liaison role on behalf of TC 7.5:

Jim Gartner – TC 7.3 Operations and Maintenance Management

Damian Ljungquist – TC 1.4 Control Theory and Applications; SPC 135 BACnet
Dave Bornside – TC 7.9 Commissioning

Following-up on the discussion of liaisons outside the ASHRAE committee structure, John Murray of TC 10.7 recommended the Food Marketers Institute annual conference as an opportunity to meeting with individuals interested in supermarket energy issues. The next conference is in September in Phoenix. More information can be found at www.fmi.org.

3. House suggested that TC 7.5 consider moving to a paperless meeting format. Some committees within ASHRAE are either doing this now or are planning to start conducting paperless meetings. A wireless network with a laptop running a server application would be set up to allow file sharing. A data projector could be used to project documents for individuals who either did not have a laptop or were restricted in how they use their laptop. Brambley expressed concern about restrictions that limit peer-to-peer networking on company laptops. Other attendees indicated that the networking is not peer-to-peer, but rather one computer would be used as a server from which others on the network could download files. Brandemuehl reported that a representative from ASHRAE's Electronic Communications Committee implied that ASHRAE may be moving toward instituting paperless meetings meeting-wide. Brambley also expressed concern about new attendees who might not have a laptop and who might feel left out of the discussion. He urged the committee not to forget about these individuals. The suggestion was made that CDs containing the files exchanged at the meeting could be given to these individuals. No actions were identified stemming from this discussion.

ACTION: Castro will investigate what hardware and software are necessary to enable a paperless meeting with file sharing over a local network.

4. House announced the following roster changes, effective July 1, 2006:
 - Rolling off as voting members: Osman Ahmed, Cliff Federspiel, Agami Reddy, and John House
 - New voting members: Carol Lomonaco, Bob Old, Todd Rossi, and Jin Wen

House also announced leadership changes within the committee. The new leadership is as follows:

Effective July 1, 2006

- Mike Brambley: Chair & ALI Coordinator
- Peng Xu: Vice Chair & Research Chair
- Michael Kintner-Meyer: Secretary
- Jin Wen: Fault Detection and Diagnostics
- Bill Healy: Wireless Applications
- Rich Hackner: Building/Utility Interface
- Carol Lomonaco: Program
- John House: Handbook
- Natascha Castro: Web Master

House thanked the outgoing subcommittee chairs on behalf of the TC.

Adjourn

Motion: Move to adjourn. Motion: Jim Gartner; Second: Steve Blanc.

Vote: Motion approved by unanimous voice vote.

Appendices

- A. Call to Meeting and Agenda
- B. Scope and Organization
- C. Fault Detection and Diagnostics Subcommittee Meeting
- D. Wireless Applications Subcommittee Meeting
- E. Building Utility Interface Subcommittee Meeting
- F. Research Subcommittee Meeting
- G. Program Notes
- H. 1274-RP PMSC Notes
- I. 1275-RP PMSC Notes
- J. 1312-RP PMSC Notes
- K. List of Subcommittee and Committee Attendees

Appendix A. TC 7.5 Call to Meeting and Agenda

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

1791 Tullie Circle, NE, Atlanta, Georgia 30329-2305

404-636-8400 | Fax 404-321-5478

Reply to: John House
CANMET Energy Technology Centre
1615 Lionel-Boulet Blvd., P.O. Box 4800
Varennnes, Quebec J3X 1S6
CANADA
John.House@NRCan.gc.ca

June 6, 2006

Dear TC 7.5 Member, International Member, or Corresponding Member:

The **TC** on Smart Building Systems will meet in the Quebec Convention Center according to the following schedule:

TC 7.5	Fault Detection & Diagnosis	Sunday (6/25)	3:00-4:00p	CC 303A
TC 7.5	Wireless Applications	Sunday (6/25)	4:00-5:00p	CC 303A
TC 7.5	Building/Utility Interface	Sunday (6/25)	5:00-6:00p	CC 303A
TC 7.5	Research	Monday (6/26)	2:00-3:00p	CC 206A
TC 7.5	Smart Building Systems	Tuesday (6/27)	3:30-6:00p	CC 302B

TC 7.5 is sponsoring the following program sessions:

Seminar 11: End-Users Report on Fault Detection and Diagnostics, Part 1
Sunday, June 25, 2006, 10:45 AM – 12:15 PM

Seminar 19: End-Users Report on Fault Detection and Diagnostics, Part 2
Sunday, June 25, 2006, 1:30 PM – 3:00 PM

Attached is a draft agenda for the full TC 7.5 committee meeting. I hope to see you all in Quebec City.

John House
Chairman, TC 7.5

**ASHRAE TC 7.5, Smart Building Systems
2006 Annual Meeting
Quebec City, QC**

AGENDA

Location: Quebec Convention Center
Date: Tuesday, June 27, 2006
Time: 3:30 - 6:00 p.m.

1. Roll Call and Introductions

2. TC 7.5 Scope

TC 7.5 is concerned with the performance and interactions of smart building systems, the impact of smart systems on the total building performance, methods for achieving more intelligent control and operation of building processes, interactions of smart buildings with utilities, and documentation of the benefits of smart buildings and smart building systems as they relate to energy consumption, cost of operation, maintenance, occupant comfort, building commissioning, operations, and impact of the SBS on utilities and natural resources.

3. Approval of Chicago Minutes

4. Announcements

5. Fault Detection and Diagnosis Subcommittee (Natascha Castro)

6. Wireless Applications Subcommittee (Peng Xu)

7. Building/Utility Interface Subcommittee (Srinivas Katipamula)

8. Research (Mike Brambley)

9. Program (Rich Hackner)

10. Handbook (Les Norford)

11. Web (Natascha Castro)

12. Homeland Security

13. Old Business

14. New Business

- Roster changes

15. Adjournment

Appendix B.

TC 7.5, Smart Building Systems Scope and Organization

Revised July 1, 2001

Overall Committee Scope

The Technical Committee on Smart Building Systems (SBS), TC 7.5, is concerned with the development and evaluation of technologies that could enable the widespread application of smart building systems. “Smart” buildings should take advantage of automation, communications, and data analysis technologies in order to operate in the most cost-effective manner. This implies integration of building services such as HVAC, fire, security, and transportation; the automation of many of the operation and maintenance functions traditionally performed by humans; and the interaction with outside service providers such as utilities, energy providers, and aggregators. Currently, three subcommittees form the backbone of the TC’s activities: fault detection and diagnostics, wireless applications, and building/utility interface.

Appendix C.

TC 7.5 Fault Detection and Diagnostics Subcommittee Meeting

Quebec City, Quebec: Sunday, June 25, 2006, 3:00-4:00pm

Natascha (Chair) began the meeting with a review of the meeting agenda and presented the list of ongoing research projects:

4. 1274 RP, “Field Performance Assessment of Packaged Equipment to Quantify the Benefits of Proper Service.” [PMSC Chair: Todd Rossi]
5. 1312 RP, “Tools for Evaluation FDD for AHUs” [PMSC Chair, Phil Haves]
6. 1275 RP, “Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers - Phase II.” [PMSC Chair, Phil Haves]

Srinivas Katipamula presented a draft work statement which has been under development as a follow on to the ongoing 1275 RP, “**WS Chiller Phase III – Fault Detection and Diagnostics for Centrifugal Chillers, Phase III: Real Time Implementation.**” The main comments that arose out of discussions are as follows:

It is important to specify the size of the chillers so that the bidders are aware of the preference of committee for the project, though there was some concern that over-specifying may restrict bidders. It was also stated that the WS should be written so as to eliminate the possibility of the Phase III equipment exactly matching the Phase II specifications (90 ton,...)

Task 3 does not require that faults be introduced in the field. It may be difficult to find installations where this would be permitted, but the WS should specify that points will be given to bids that include this.

Status of Phase II, draft version of final report was reviewed by PMS. They recommended acceptance w/ changes. Final report will be submitted at the end of July to close the project.

It was suggested that an email ballot follow review/endorsement of the work statement by TC 8.2 (Centrifugal Machines).

The second item of business was a discussion of draft RTARs:

1. “**Fault Detection and Diagnostic Methods for Supermarkets**” [RTAR Champion: John House]
 - ❖ Carl Roberts is the interface with TC 10.7. There are very small profit margins which drives competition and non-disclosure. Suggested that manufacturers would be a good source of challenges & opportunities. Availability of sensors in increasing for refrigeration equipment. This would be a great opportunity. There needs to be more work on how to define common faults, including malfunctions and identifying non-ideal settings)
 - ❖ Southern California Edison may also be working in this area with some funding from CEC. ARTI may also be a good source. Europe requires measurement and trending for several classes of refrigeration cases (e.g. meat/cheese).
 - ❖ Question that needs to be answered, Is our focus on refrigeration or whole building?
 - ❖ WS required by August 07.
2. “**A Building Systems Emulation Tool for Building Operators**” [RTAR Champion: Steve Blanc]
 - ❖ Background: a “what-if emulator for buildings” help of training, operation, fdd-connected to the real building operation system. Not a proof of concept, but how to develop something that can be turned into a tool- a high-order specification.
 - ❖ Contributions have been made by Holmberg, Haves,
 - ❖ Discussion delayed to Research Subcommittee.
 - ❖ A revised RTAR to be prepared for Dallas

The third item of business was a discussion of new research ideas.

1. Reddy: California has a large development in building metering, What could be done to identify problems using interval?
2. Out of comments from end-user needs for simple tools, How can we provide answers to users needs, including providing detailed information on advice for repair? An ASHRAE resource will be the Repair Cost Database which quantifies O& M savings which will be available in July. There is also a CEC project which has a placeholder for rate of return...

The fourth item of business was a discussion of program. Two good seminars presented the end-user's reality for FDD. Future program ideas include:

1. (Rejected for Quebec) Follow on Forum *FDD, Are you ready to put it in your Building?*
2. (Dallas)Symposium *Software Tools for Enhanced Building Operation*
 - ❖ Lead: John House, Only have 2 papers at present, Co-sponsors: 7.9?
3. (Future) Seminar:*FDD...Fault Detection and Diagnostics...but What about "Correction?"*
 - ❖ Lead: Someone from PNNL? 2 presentations, Blanc may add one.Co-Sponsors: TC 7.4?

Appendix D.

TC 7.5 Wireless Applications Subcommittee

Sunday, June 25, 4:00 to 5:00 pm
Quebec City, Canada
Minutes

The subcommittee meeting convened around 4:00 pm with Michael Brambley chairing in place of Peng Xu, who was unable to attend the meeting.

Review of current research ideas:

- Development of metrics to evaluate benefits of sensor networks in buildings (Bill Healy, lead): Bill was not present at the meeting. Brambley volunteered to contact Healy to determine whether the RTAR could be ready for submission in August or September. If not, it would be considered by the committee in Dallas.
- Control network faulty behavior (Cliff Federspiel, lead): Cliff was not present at the meeting. Meeting participants pointed out that this topic is just at the idea stage. Jin Wen volunteered to assist Cliff in preparing the RTAR and Srinivas Katipamula volunteered to serve as a reviewer for the draft.
- Practical issues of using wireless technology in building control (Bob Old, lead): Bob reported that no progress had been made since the last meeting. He volunteered to prepare a first draft of the RTAR or a one-paragraph description for purposes of clarifying the topic for distribution before the Dallas meeting. Carol Lomonaco volunteered to assist Bob.

New business

- Agami Reddy raised the issue that wireless technology is now available but there is no guidance for its use, suggesting that TC 7.5 should initiate some activities to develop such guidance. This led to discussion of what is actually available for practical use vis a vis underlying technology available and promises of technology available that possible exceed what is actually available commercially for applications to buildings and HVAC systems. From this conversation emerged three ideas for possible program topics:
 - Emerging wireless technology and applications
 - Sensing technology and applications
 - Deployment of wireless

Program

- Carol Lomonaco led further discussion of possible program proposals, including review of the following ideas proposed at earlier meetings.
 1. Forum: Control network faulty behavior (Cliff Federspiel)
 2. Seminar: practical experience of wireless and control network in building. (Mike Brambley) (Long Beach).
- Further details on program will be provided in Carol's report on the program.

The meeting adjourned at 5:00 pm.

Appendix E.

TC 7.5 Building/Utility Interface Subcommittee Meeting

TC 7.5 Building/Utility Interface Sub-Committee Minutes

2006 ASHRAE Summer Meeting, Quebec City, Canada - June 25th, 2006

The meeting began at 5:00 p.m. with about 10 people in attendance. Please refer to the main TC committee minutes for attendance list.

Srinivas Katipamula, the sub-committee chair, began the meeting by announcing that the TC Chair created this new sub-committee before the last meeting in response to members request to re-focus the research areas. This is second meeting for the subcommittee. The draft scope was circulated for members to provide feedback and changes by email. The draft objectives of the sub-committee are:

This new subcommittee will explore and develop ideas and research work statements to improve the building and utility interactions (and more specifically the electric grid). The research will focus on developing enabling technologies for seamless interaction of smart building components and utilities and other building services. An important aspect of this work is to identify the information that is necessary to support smart building technologies, and to identify the requirements of communication protocols to support the exchange of this information between different building services, between buildings and utilities, between multiple buildings, with outside service providers.

The importance of a stable and reliable electric power grid to life and the economy in the 21st century has been underscored by two major events over the last decade: a major black out on the east coast of North America and wildly varying electricity prices in California during an attempt at restructuring the electricity marketplace. In response to these events many organization (DOE, EPRI, and CEC) have started research activities to find ways to modernize the grid. However, there are significant gaps in the research activities, especially as they relate to buildings. Since buildings consume over 70% of the electric in the U.S., they have to part of the solution to modernize the grid. ASHRAE has traditionally developed technologies, standards, and guidelines for buildings. Therefore, this subcommittee can play a major role in continuing this effort.

After introducing the objectives the sub-committee chair listed two potential research topics for discussion:

- Building response/control for scheduled and unscheduled power interruptions, especially prioritization of loads, equipment and control, when they occur (i.e. when power goes "off"), including integration of UPS systems.
- Building/controls response when power comes back "on." One example, how can buildings "soft re-start" after a power outage that is either of short (less than an hour) or long duration (several hours)

After some discussion about the above topics, the committee decided that we need more focused ideas. Rich Hackner volunteered to draft a RTAR for the next meeting on commercial building demand response and Jin Wen volunteered to draft a RTAR on residential building demand response.

Srinivas noted that this is his last meeting as a chair of this subcommittee; Rich Hackner is going to take over as the chair starting next meeting.

Appendix F.
TC 7.5 Research Subcommittee Meeting
Monday, June 26, 2006, 2:00 – 3:00 p.m.
2006 Annual Meeting
Quebec City, Quebec, Canada
Minutes

The meeting convened at approximately 2:00 p.m. chaired by Mike Brambley.

1. The first order of business was to review the agenda and revise if necessary. Copies of the agenda were distributed, after which Mike asked if there were any proposals for revisions. None were requested.
2. Announcements: The second order of business was announcements. Mike reviewed the changes initiated by TC chair, John House, asking the Research Subcommittee to gather reports for the various topical subcommittees on their research and then for the Research Subcommittee chair to provide a summary report on the status of research at the full committee meeting.

Also mentioned was the move of the research subcommittee meeting to Monday at 2:00 p.m. to provide more time for the topical subcommittees to cover all of their business on Sunday.

3. PMSC Reports on Research Projects: The third order of business was review of the status of the ongoing research projects, reports of which follow.
 - a. 1274-RP: Field Performance Assessment of Package Equipment to Quantify Benefits of Proper Service (Todd Rossi, PMSC Chair). Todd Rossi was unable to attend the meeting, but the meeting of the PMS for 1274-RP with the contractor was held Sunday evening. Mike Brambley and Steve Blanc reported on that meeting as follows.

There still seems to be difficulty in getting all PMS members to the meetings, particularly at this meeting in Quebec City. The contractor has completed testing of 148 packaged units out of a total planned of 375. Despite this, there are issues remaining on the test protocol. Todd Rossi has worked with the contractor to iron out most of those issues and a revised protocol is nearly in place to move forward on tests on the remaining units. The revised protocol has been tested on four units.

The revised protocol appears to be adequate, but the tests completed to date may not be usable because they were made using a different protocol for which significant issues were discovered (thus, requiring the protocol revision). These tests already completed represent nearly 40% of the total planned. This may create a problem with statistical significance of the results for the project. This will be investigated further and the Section research head consulting on how best to move forward. If a sufficient number of units were originally selected (375) so that the remaining number should provide significant results, then the project will move forward as

planned presently. If the remaining units will not provide a sufficiently large sample, then other options need to be considered.

ACTION: Follow up on examining the original statistical analysis. Hold PMS conference call.

- b. 1275-RP: Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers—Phase II (Phil Haves, PMSC Chair). Phil was not able to attend the Research Subcommittee meeting and Srinivas Katipamula reported on his behalf.

Srinivas reported that a no cost time extension through August 2006 was approved. The contractor has submitted the final report. Four methods were examined in the project and the rule-based and multiple linear regression approaches were selected as the best. The PMS held a conference call on Tuesday prior to this meeting. They unanimously voted for the report to be accepted with six changes and editing (which will be designated in the PMS report).

- c. 1312-RP: Tools for Evaluating FDD Methods for AHUs. Srinivas Katipamula reported on this project. Drexel University is the contractor. Phil Haves is the PMS chair. A conference call of the PMS was held the Thursday before the ASHRAE meeting. About half of the PMS participated.

The status of the project as of 7 to 8 months ago was as follows. The contractor was putting together a simulation environment for evaluating FDD. They plan to use the dynamic cooling coil model from TC 7.4 project in the environment. The simulation environment is essentially complete except for debugging a few new modules. After debugging, they will then integrate the cooling coil model.

The Task 3 report was due at the end of June but is not yet done. It will be done by the end of August or mid-September. The project is approximately 3 to 4 months behind the original schedule. A conference call will be scheduled after the Task 3 report is completed.

- 4. The fourth order of business was to briefly review the meetings and key actions underway by the topical subcommittees. Reports were provided as follows.

- a. Fault Detection and Diagnosis (Natascha Castro):
Natascha reported that the work statement for the Chiller project Phase 3 was discussed. The main outcome was the Srinivas Katipamula is to talk to TC 8.2 regarding their review and endorsement of this work statement.

Two additional RTARs were discussed:

- 1. Supermarkets RTAR: Where to get additional data and information was discussed. The RTAR expires in August 2007. A work statement draft will be ready for the next meeting.
- 2. Building Evaluation Tool: Steve Blanc, the lead, reported that he is working on it with Phil Haves and David Holmberg. An early draft was distributed to volunteers for review and comment earlier.

John House suggested that SCE might be doing some research. We should talk to them and see if ASHRAE could possibly cofund.

- b. Wireless Applications (Peng Xu): Mike Brambley reported for Peng Xu. Mike reported that leaders for two key research ideas under development were not present but volunteers were obtained to assist with preparation and revisions of RTARs. These two topics are:
 - i. Development of metrics to evaluate the benefits of sensor networks for buildings (Bill Healy, lead)
 - ii. Control network faulty behavior (Cliff Federspiel, lead)

Mike further reported that further discussion led to some promising program ideas but no new research.

- c. Building/Utility Interface (Srinivas Katipamula): Srinivas reported that he first reviewed the scope of the subcommittee. The subcommittee then discussed potential research topics:
 - i. Building response and control for scheduled and unscheduled power interruptions, especially prioritization of loads, equipment and control, when the power goes off.
 - ii. Building and controls response when power comes back on, after being off.

After the discussion the subcommittee decided it needed more focused ideas. Rich Hackner volunteered to draft an RTAR for the next meeting on commercial building demand response, and Jin Wen volunteered to draft an RTAR on residential building demand response.

5. New Business

Ideas were suggested for new research including:

- a. California has a large building metering development underway. Something might be done to identify problems.
- b. More detailed tools or application guidance
- c. O&M cost database

6. Adjourned at 3:00 pm.

Appendix G. Program Notes

History – Program Plan for Quebec City

- Priority 1 Seminar “*End Users Experience with Fault Detection and Diagnostics: Part 1*”
 Chair: Mark Cherniack
 Co-Sponsors: TC 1.4
Status: **Seminar 11, Sunday, June 25th. Approximately 60 people**
- Priority 2 Seminar “*End Users Experience with Fault Detection and Diagnostics: Part 2*”
 Chair: Adrienne Thomle
 Co-Sponsors: TC 1.4
Status: **Seminar 19, Sunday, June 25th. Approximately 40 people**
- Priority 3 Forum “*Automated Fault Detection and Diagnostics: What Would Make it Ready for Your Building?*” (Chair: Michael Brambley)
 Co-Sponsors: TC 1.4
Status: Not Approved

Important Program Deadlines

MEETING SITE AND DATE	DATE TECHNICAL PAPERS ARE SUBMITTED TO BEGIN REVIEW PROCESS	DATE FOR ALL COMPLETED SYMPOSIUM, SEMINAR AND FORUM PACKAGES TO BE SUBMITTED and TECHNICAL PAPERS TO FINISH REVIEW
Chicago, Illinois January 21-25, 2006	April 1, 2005	August 5, 2005
Quebec City, Canada June 24-28, 2006	September 23, 2005	February 10, 2006
Dallas, Texas January 27-31, 2007	April 7, 2006	August 4, 2006
Long Beach, California June 23-27, 2007	September 29, 2006	February 9, 2007

Other Ideas for Dallas and Beyond

Seminar “*Peel and Stick....The Future in HVAC Sensing Technology?*”

Lead: Michael Brambley

Co-Sponsors: TC 1.4?

Possible Speakers: Mike Schell and Glen Remington

Forum “*FDD Needs for Data Centers*”

Lead: Phil Haves

Co-Sponsors: TC 7.4, TC 9.9 Mission Critical Facilities?

Forum “*What Makes a Smart Building “Smart”*”

Lead: ???

Co-Sponsors: TC 7.4

Appendix H.

1274-RP PMSC Notes

See Appendix F, item 3.a.

Appendix I.

1275-RP PMSC Notes

See Appendix F, item 3.b.

Appendix J.

1312-RP PMSC Notes

Conference Call, June 22, 2006

Attendance: Phil Haves (Chair), Srinivas Katipamula, James Coogan

Contractor: Drexel, Jin Wen and Agami Reddy

Jin Wen from Drexel University provided a draft progress report a week before the schedule meeting. This meeting was to access the progress of the research project.

The research project is to develop an air handling unit (AHU) simulation tool. This tool is to be developed using existing modules (HVACSIM+, ASHRAE toolkits, etc.). In addition, this tool is required to use the dynamic cooling coil model developed by Purdue.

Phil Haves started the meeting by asking the PMS members if they had any questions. PMS members had several questions for the contractor and made some suggestion on how to proceed. Although the project is behind schedule the PMS is confident that the contractor is on track.

The contractor has finished assembling the simulation tool and is currently debugging the tool. Because three new modules were developed there is some problem in integrating them with the rest of the tool. The dynamic cooling coil module hasn't been integrated yet. Work to be completed between now and the winter meeting is listed below:

1. Finish debugging the code and validate the tool with fault-free data by end of August.
2. Integrate the Purdue dynamic cooling coil model also by end of August.
3. Finish Task 2 report (Description of the Simulation Environment) by middle of September.
4. Finish Task 3 report (Validation procedure) by middle of October.
5. Start experiments in Energy Resource Center in January, 2007.
6. Schedule a conference call end of August.

Appendix K.

List of Subcommittee and Committee Attendees

Quebec City – June 2006

	Main Committee	Fault Detection & Diagnostics	Wireless Applications	Building / Utility Interface	Research
Voting Members					
Osman Ahmed (V)					
Steve Blanc, (V)	X	X	X	X	X
Michael Brambley, Vice Chair, Research Subc., (V)	X	X	X	X	X
Michael Brandemuehl (V)	X	X			
James Braun (V)					
Cliff Federspiel (V)					
James W. Gartner, (V)	X				
Bill Healy (V)					
John House, Chair (V)	X	X	X	X	X
Agami Reddy (V)	X	X	X		
Jonathan Wright, International Member (V)					
Peng Xu, Wireless Apps. Subc., (V)					
Corresponding Members					
Narendra Amarnani, CM					
David Bornside, CM	X				
Dave Branson, CM					
Barry Bridges, CM					
Marty Burns, CM					
Jim Butler, CM				X	
Natascha Castro, Testing & Eval Subc, Web Master, CM	X	X	X	X	X
Maria Corsi, CM	X	X	X	X	X
Charles Culp, CM					
Arthur Dexter, CM					
Piotr Domanski, CM		X			X
Mohsen Farzad, CM					
Rich Hackner, Prog. Subc., CM	X	X	X	X	X
Carlos Haiad, CM					
Philip Haves, CM					
Mark Johnson, CM					
David Kahn, CM					
Srinivas Katipamula, Bldg./Util. Int. Subc., CM	X	X	X	X	X
George Kelly, CM	X	X	X	X	X
Michael Kintner-Meyer, CM					
Mingsheng Liu, CM					
Carol Lomonaco, CM	X	X	X	X	X
Darrell Massie, CM					
John Mitchell , CM					
Ron Nelson, CM					
Les Norford, CM	X				
Robert Old, CM	X	X	X	X	X

	Main Committee	Fault Detection & Diagnostics	Wireless Applications	Building / Utility Interface	Research
Hung Mahn Pham, CM					
Kinga Porst, CM					
Michael Pouchak, CM					
Andrew Price, CM					
Barry Reardon, CM					
Glenn Remington, CM					
Todd Rossi, Secretary, CM					
John Seem, CM	X	X			
Vernon Smith, CM					
Pornsak Songkakul, CM					
Keith Temple, CM	X				X
Jin Wen, CM	X	X	X	X	X
James Winston, CM					
Chariti Young, CM					
Xiaohui Zhou, CM	X				
Incoming Corresponding Members					
Martha Brook					
Sharon Dinges					
Ahmad Husaunndee					
Ashok Kadakia					
Bill Pienta				X	
Gene Strehlow	X				
Arun Vohra					
Guests					
Mark Cherniack		X			
Louis Coughenour		X			
James Earley	X				
Sira Gopalnarayanan	X				
David Holmberg			X	X	
Patrick Hughes	X	X	X	X	X
Richard Kelso		X			
Eleanor Lee		X	X	X	X
Damian Ljungquist	X				
Haorong Li	X	X	X	X	X
Scott Mitchell	X	X		X	
John Murray	X				
Brendan O'Neill					X
Janice Peterson	X				
Mike Porter	X	X			
Carl Roberts		X			
Meli Stylianou	X	X	X	X	X
Kris Subbarao	X	X			
Tom Sumner		X			
Shengwei Wang	X				
Jerry While	X				